A STUDY OF URINARY TRACT INFECTION IN BLADDER CATHETERIZED PATIENTS – A SERIES OF 110 CASES

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CERTIFICATE

This is to certify that the dissertation titled "**A STUDY OF URINARY TRACT INFECTION IN BLADDER CATHETERIZED PATIENTS – A SERIES OF 110 CASES"** presented here is the original work done by **Dr. D. MANIKANDAN** in the Department of General Medicine, Government Stanley Hospital, Stanley Medical College, Chennai – 600 001, in partial fulfillment of the University rules and regulation for the award of M.D. DEGREE BRANCH I GENERAL MEDICINE – under my guidance and supervision during the academic period from 2007 – 2008.

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DECLARATION

I, **Dr. D.MANIKANDAN**, solemnly declare that the dissertation titled "**A STUDY OF URINARY TRACT INFECTION IN BLADDER CATHETERIZED PATIENTS – A SERIES OF 110 CASES"** was done by me at Government Stanley Medical College & Hospital during 2007 – 2008 under the guidance and supervision of my unit chief, **Prof. S. MAGESH KUMAR, M.D**.,

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CONTENTS

INTRODUCTION

The urinary tract is the most common site of nosocomial infection. Most of these infections follow instrumentation of the urinary tract, mainly urinary catheterization and are also a major source of resistant nosocomial pathogens. Catheter-associated urinary tract infection (CAUTI) is the most common nosocomial infection in hospitals and nursing homes, comprising >40% of all institutionally acquired infections (Kunin, 1997). Nosocomial bacteriuria or candiduria develops in up to 25% of patients requiring a urinary catheter for > 7 days, with a daily risk of 5%. Although not all catheter-associated urinary tract infections can be prevented, it is believed that a large number could be avoided by the proper management of the indwelling catheter.

AIM OF THE STUDY

The aim of the study is to analyze the incidence, clinical symptoms, microbiological flora, sensitivity of organisms of urinary tract infection in bladder catheterized patients and the influence of the days of catheterization in catheter associated urinary tract infection.

REVIEW OF LITERATURE

Definitions

Bacteriuria:

Bacteria are found in the urine, irrespective if there are symptoms of urinary tract infection or not.

Asymptomatic bacteriuria*:*

Significant bacteriuria (more than 10^8 bacteria/L) without symptoms.

Urinary tract infection:

An infection localized somewhere in the urinary tract. May include asymptomatic bacteriuria but mostly only symptomatic infections.

Symptomatic urinary tract infection:

Presence of symptoms caused by the urinary tract infection, as opposed to asymptomatic bacteriuria.

Cystitis:

Inflammatory syndrome and infection of the bladder with signs and symptoms of dysuria, frequency, urgency, and suprapubic tenderness.

Pyelonephritis:

Bacterial infection of the kidney (renal parenchyma, calices, and pelvis) involving flank pain, tenderness, and fever, and often associated with dysuria, urgency, and frequency. May be acute or chronic.

Urethritis:

Lower urinary tract inflammation without bacterial infection, causing symptoms similar to those of cystitis. But it can also be associated with bacterial infections producing sexually transmitted diseases such as Chlamydia trachomatis and Neisseria gonorrhea.

Prostatitis:

Encompasses several different clinical entities, from bacterial infection to inflammation to pain, which cause symptoms related to the prostate gland. Chronic bacterial prostatitis is a remitting condition with variable symptoms present for more than 3 months.

Leukocyturia:

Leukocytes (white blood cells) are found in the urine

Uncomplicated urinary tract infection:

Infection in a patient with a normal, unobstructed genitourinary tract with no prior instrumentation.

Complicated urinary tract infection:

Infection in a patient with structural or functional abnormalities. This also includes men, pregnant women, children, presence of foreign body (urinary catheter, stone, tumour) and sometimes upper urinary tract infection.

Relapse:

Recurrence of bacteriuria with the same microorganism present before initial therapy was started, due to persistence of the organism in the urinary tract.

Reinfection:

Recurrence of bacteriuria with a new microorganism. Reinfection is difficult to differentiate from relapse when infection occurs with a microorganism of the same species as the initial infection.

Urinary tract infection

Historical remarks

Curtis Nickel made an historical review of urinary tract infections in 2005; some key points are presented below: From ancient China (3000-2000 B.C.) there are texts discussing the inspection of urine as an important diagnostic tool. In classical Greece, Hippocrates gave detailed descriptions of medical conditions in the kidneys and urinary tracts, and in ancient Rome Celsius [24] provided a detailed explanation of urinary catheterisation using bronze catheters. Aetius from Amida (Middle East, 500 A.D.) described urine examination (uroscopy) for clarity, colour, smell, cloudiness and presence of deposits and blood. It was then practiced in Europe for hundreds of years, until the time of the Renaissance. In the Renaissance (approximately 1500 to 1750), there were advances in anatomy and surgery but it was not until the 19th century that an understanding of disease etiology emerged. As for infectious diseases, Dutch microscopist Antony van Leeuwenhoek in the 17th century had managed to see small microorganisms, but it was not until the mid- 19th century that the etiology of infectious disease began to be clarified.

The intestinal bacterium Escherichia coli (E. coli), the most common and important bacterial species in urinary tract infections, was discovered in 1885 by German pediatrician Theodor Escherich, and later named after him.

Despite the discovery of bacteria as the cause of infectious diseases, it took many years for it to be understood that bacteria could cause diseases in the urinary tract. Around the turn of the twentieth century antiseptics were coming into use for urinary tract infections, but more successful treatments were not available until the introduction of sulphanilamide in 1937 [25]. Sulphanilamide was effective for treatment of infections in the urinary tract but was unfortunately associated with serious side effects, substantially reducing its therapeutic usefulness. Nitrofurantoin, still in first line use today, was introduced as early as 1953 as a safe and effective treatment for uncomplicated urinary tract infections. In 1962, nalidixic acid, a prototype to the fluoroquinolones, was introduced. Trimethoprim and β-lactams (ampicillin, mecillinam and cephalosporins) effective for treatment of urinary tract infections, came in to use in the 1970s.

Diagnosis by Kass' criteria:

In the 1950s, American microbiologist Edward Kass [26] carried out classical studies on the interpretation of quantitative urinary cultures in relation to the diagnosing of urinary tract infections in an attempt to sort out

those cultures that were not truly positive but only contaminations. Kass studied women with pyelonephritis [27] and women without symptoms of urinary tract infection. In women with pyelonephritis, 95% had a urinary bacterial count of $\geq 10^8$ colony forming units/litre (cfu/L) while most asymptomatic women had no bacterial growth or a bacterial count of $<10^6$ cfu/L even in repeated cultures, giving a dividing line between the true bacteriuria in pyelonephritis and contaminated samples in asymptomatic subjects. Kass' findings resulted in the concept of significant bacteriuria ($\geq 10^8$ cfu/L), as a diagnostic indication of urinary tract infection; smaller bacterial counts were regarded as contaminations (Kass' criteria). However, some of the asymptomatic women were also found to have a urinary bacterial count of $\geq 10^8$ cfu/L, and this result was verified in repeated, consecutive samples from the same individuals, confirming the presence of asymptomatic bacteriuria.

Epidemiology

Urinary tract infections are one of the most common bacterial infections [1] in humans. They are common among sexually active women and, except in the first months of life, more common in women than in men. In adult women the incidence of urinary tract infection in 12 months is 10.8-13.3% and the lifetime risk of urinary tract infection in women is estimated

at 50- 60%. The highest incidence rate is seen in women aged about 20, after which there is a slow decrease toward middle age and then a gradual increase from about 65 years of age. In young men the 12 month incidence of urinary tract infection is only about 1%, but increases from about 65 years of age to 7-8% above 80 years. However, in old age the population of women is markedly larger than that of men. Consequently, women account for a proportionally larger proportion of the urinary tract infections treated in the health care system. This fact also in part explains studies on women being more common than on men, resulting in inferior knowledge about men and urinary tract infections. As urinary tract infections are often transient and self-healing, the real incidence in younger populations is probably higher. In contrast, the high occurrence of asymptomatic bacteriuria may result in over-estimation of the real incidence of symptomatic urinary tract infections in the elderly.

Recurrent urinary tract infections are common, and the majority of people having urinary tract infections have a history of two or more such infections in their lifetimes. There are subpopulations that are more prone to developing urinary tract infections, such as pregnant women [(28)], patients with catheters, and patients with spinal cord injuries, diabetes, multiple sclerosis or HIV infection. Among non- institutionalized elderly people [(37)],

genitourinary infections are the second most common infections (after respiratory tract infections), accounting for nearly 25% of all infections.

Clinical presentations

The most common presentation of symptomatic urinary tract infection is acute cystitis, which constitutes approximately 90% of the episodes of urinary tract infections. Acute cystitis is an infection engaging the lower urinary tract, resulting in an inflammatory response in the bladder and urethra, causing leukocyturia and focal symptoms such as dysuria (painful urination), urgency (sudden compelling desire to urinate) and frequency (frequent urination). The diagnosis in women is based primarily on typical symptoms, and a urinary test is in most cases unnecessary.

Although the symptoms of acute cystitis can be very troublesome, it is generally innocuous and self-healing, and the primary reason for antibiotic treatment is to shorten the time with symptoms. Untreated acute cystitis only occasionally progresses to pyelonephritis. In acute pyelonephritis the infection involves the kidneys and causes focal symptoms such as flank pain and signs of systemic inflammation with fever and general malaise. In pyelonephritis there are sometimes, but not always, concomitant symptoms from the lower urinary tract. Focal symptoms from the upper urinary tract are sometimes absent, especially among elderly patients, and the only

symptom may be fever and general malaise. Bacteraemia (occurrence of bacteria in the blood) is found in 20- 30% of patients with febrile urinary tract infections. Signs and symptoms of urinary tract infection in men are similar to those in women. Major predisposing factors are genitourinary instrumentation and urinary obstruction due to prostatic hypertrophy. In addition to these clinical presentations of symptomatic urinary tract infections, there is sometimes bacteriuria (bacteria in the urine) in a subject with no symptoms of a urinary tract infection i.e., asymptomatic bacteriuria.

Asymptomatic bacteriuria

Definition

According to the most common definition, asymptomatic bacteriuria [(4)] occurs in a patient when, without symptoms of urinary tract infection, in two voided consecutive urine samples, he or she shows growth of the same bacterial strain with a count of $\geq 10^8$ cfu/L. In men, there is support for the use of a definition of only one voided sample with growth of $\geq 10^8$ cfu/L to confirm asymptomatic bacteriuria. This applies even for men using a freshly applied condom catheter.

A urine sample obtained by urethral catheterization showing one bacterial species with a count $\geq 10^5$ cfu/L identifies asymptomatic bacteriuria in both women and men.

Prevalence

The prevalence of asymptomatic bacteriuria in schoolgirls is about 1%, in women up to 50 years, including pregnant women, 1-5% [22]. From about 50 years of age the prevalence increases from 3 to 9% to around 20% in women aged 80 and over. Asymptomatic bacteriuria, like symptomatic urinary tract infections, is more prevalent among sexually active women. Asymptomatic bacteriuria is uncommon in young men (<1%) but the prevalence increases from the age of 60 up to 5-10% in men aged 80 and over.

In the elderly [22] living in institutions asymptomatic bacteriuria is very common. In women, the prevalence is found to be 25-50% and in men 15-40%. These figures vary depending on differences in populations studied, and whether one or two cultures were required for diagnosing asymptomatic bacteriuria. In women and men who have chronic indwelling urinary catheters, the prevalence of bacteriuria is almost 100%.

In women with diabetes the prevalence of asymptomatic bacteriuria is higher than in age-matched non-diabetic women, while diabetic and nondiabetic men seems to have asymptomatic bacteriuria to the same extent. Although asymptomatic bacteriuria is often transient in young and middle-aged women, as in elderly women and men, a considerable proportion of

individuals have bacteriuria repeatedly. In young girls, persistent asymptomatic bacteriuria (Escherichia coli) was mostly attributable to infection with the same bacterial strain, and a change of strain was often a result of antibiotic treatment.

Clinical importance

Children

Asymptomatic bacteriuria in children is well investigated. It may persist for many years without evidence of any adverse outcomes. In children there are in fact indications that asymptomatic bacteriuria may prevent infections with more virulent bacterial strains, and that antibiotic treatment may increase the risk of symptomatic urinary tract infections. Therefore, screening for, and treatment of asymptomatic bacteriuria in children is not recommended.

Young and middle-aged women

The prevalence of asymptomatic bacteriuria in young and middle-aged women increases with age. Known risk factors are, like for symptomatic urinary tract infections, sexual intercourse and use of diaphragm or spermicides as birth control measures. The prevalence of asymptomatic bacteriuria in sexually active women is 3-5 times higher than in women in the same age groups who are not sexually active.

There was also, in long-term follow-up (of about 15 years), an increased risk of developing symptomatic urinary tract infections as compared with women without bacteriuria.

Antimicrobial treatment of women with asymptomatic bacteriuria resulted in temporary cure in the treatment group but after one year the prevalence of bacteriuria was the same in the antibiotic and placebo groups, and equal proportions of the two groups were identified with symptomatic urinary tract infections during the year of follow-up.

In conclusion, young and middle-aged women with asymptomatic bacteriuria more often experienced symptomatic urinary tract infections and recurrent episodes of asymptomatic bacteriuria. This group of patients forms the predominant group of people presenting with asymptomatic bacteriuria. However, antimicrobial treatment did not decrease the number of symptomatic infections, and asymptomatic bacteriuria was not associated with any negative long-term side effects. Thus, asymptomatic bacteriuria in young and middle-aged women need not be screened for or treated with antibiotics.

Pregnant women

Pregnant women with untreated asymptomatic bacteriuria are at 20-30 times higher risk of developing pyelonephritis later in pregnancy than women without bacteriuria. These women also may have an increased risk for premature delivery and of having babies with low birth weight. Whether this is an independent risk or associated with the development of pyelonephritis is controversial. Antibiotic treatment is effective in reducing the high rate of pyelonephritis in pregnancy and thus screening for and treatment of asymptomatic bacteriuria in pregnancy is warranted.

Elderly living in the community

There are several long-term studies including elderly people where the effects of asymptomatic bacteriuria on morbidity and mortality have been evaluated without finding any adverse outcomes.

A randomised placebo-controlled clinical trial including ambulatory elderly women reported a lower prevalence of asymptomatic bacteriuria and follow up for six months of these patients showed no significant difference in the mortality or morbidity in the same period. Thus, screening for and treatment of asymptomatic bacteriuria in elderly people living in the community is not warranted.

Institutionalised elderly

Asymptomatic bacteriuria is very common among the institutionalized elderly. The occurrence of asymptomatic bacteriuria in this population has been shown to be associated with dementia and impaired functional status, including incontinence of urine and bowel.

An important cause of bacteriuria in this group is thought to be impaired bladder voiding owing to degenerative or vascular diseases, and in men urinary obstruction secondary to prostatic hypertrophy and even chronic infective prostatitis. However, the causality is not fully clarified.

Antibiotic treatment for asymptomatic bacteriuria in this population did not affect mortality in women or men, did not decrease the numbers of symptomatic urinary tract infections, did not reduce chronic urogenital symptoms, and did not positively affect physical and mental functioning. On the contrary, antibiotic treatment gave adverse effects and an increase in the number of bacteria resistant to antibiotics making it obvious that treatment of asymptomatic bacteriuria in the elderly living in institutions is of no benefit.

Diabetes

People with diabetes have an increased risk of developing both asymptomatic bacteriuria and symptomatic urinary tract infections, and the

symptomatic infections tend to be more severe than in non-diabetic subjects. Antibiotics have no role in the treatment of asymptomatic bacteriuria in diabetics and they do not have any role in delaying the progression of renal disease.

CATHETER ASSOCIATED URINARY TRACT INFECTIONS

Introduction

Catheter-associated urinary tract infection (CAUTI) is the most common nosocomial infection in hospitals and nursing homes world-wide constituting approximately 40% of nosocomial infections. Most patients with nosocomial urinary tract infections (UTI`s) have either had genitourinary or urological manipulation or permanent urethral catheterisation, or both. Most catheter associated urinary tract infections derive from the patient's own colonic flora. Nosocomial bacteriuria or candiduria develops in up to 25% of patients requiring a urinary catheter for > 7 days, with a daily risk of 5%. Most Catheter-associated urinary tract infections are asymptomatic and rarely extend hospitalization, but asymptomatic infections often precipitate unnecessary antimicrobial therapy. Catheter-associated urinary tract infections comprise perhaps the largest institutional reservoir of nosocomial antibiotic-resistant pathogens, the most

important of which are multidrug-resistant Enterobacteriacae other than Escherichia coli, such as Klebsiella, Enterobacter, Proteus, Citrobacter, Pseudomonas aeruginosa, enterococci, staphylococci and Candida.

History

In the 1920s, Foley introduced the self-retaining catheter. Initially it was used with open drainage, and bacteriuria was virtually universal by the end of the fourth day. With the introduction and development of modern biomaterials technology and the design of suitable receptacles, closed-catheter systems were introduced. Development of bacteriuria was delayed but was still universal after 5 to 7 days. A recent relaxation of the closed-system principle occurred with the development of a so-called flip (non-return) valve, allowing a patient to void intermittently on demand through an open catheter.

INDICATION FOR CATHETERISATION

1. Investigations and Diagnostic Purposes

a) To determine residual Urine

b) To enable bladder function test to be performed

2. Drainage

Pre or Post – Operatively, i.e.

a) To drain blood clots and debris.

b) To obtain an accurate measurement of urine output.

c) To empty the bladder before childbirth if necessary.

3. Retention of Urine

Acute or Chronic caused by:-

a) Outflow obstruction e.g. Prostate Hyperplasia or Urethral Stricture.

b) Neurological diseases e.g. Multiple Sclerosis.

c) Trauma to brain or spinal cord.

d) Spina Bifida.

4. Drug Instillation

a) Catheter Maintenance Solution

b) Chemotherapy

5. Management of Incontinence.

Definition of Catheter associated urinary tract infection

Most clinicians use a clean-voided specimen showing $>10^5$ CFU/ mL as the criterion for "significant" bacteriuria for noncatheterized patients. However, once any microorganisms are identified in urine from a patient's indwelling catheter, unless suppressive antimicrobial drug therapy is being given or started, progression to concentrations $>10^5$ CFU/mL occurs predictably and rapidly, usually within 72 hours. Thus, most authorities

consider concentrations $>10^2$ or 10^3 CFU/mL [(2)], in urine collected with a needle from the sampling port of the catheter, to be indicative of true Catheter associated urinary tract infection. This concentration can be reproducibly detected in the laboratory, and this definition is useful for therapeutic decisions and epidemiologic research.

Pathogenesis

The urethral catheter can inhibit or bypass certain defense mechanisms that would normally prevent or minimize bacteria–epithelial cell interactions, e.g. the glycosaminoglycan (GAG) layer by biofilm formation.

Bacteria can enter the urinary tract in catheterized patients at the time of catheter insertion. This is especially common in patients who have inadequate cleansing of the perineum and distal urethra; especially in patients on intermittent clean catheterization where only a limited attempt is made to cleanse the entry points before introduction of the catheter. Up to 20% of individuals will be colonised immediately after catheterization. In males the predominant route of invasion is the intraluminal, suggesting an exogenous source. It is demonstrated that the intraluminal ascent of bacteria is faster (32–48 h) than the extraluminal route (72–168 h). The taps of the urine drainage bags commonly become contaminated during use and their

regular opening to drain the urine also affords the bacteria access to the bag and migrate to the drainage tube, the catheter and bladder right after. Disconnection of the catheter from the drainage tube has also been shown to lead to contamination of the system.

Catheterization will promote the development of a biofilm between the catheter and urethral mucosa. This provides a favourable environment for bacterial invasion and proliferation via the extraluminal route. A greater proportion of bacteriuria is found in women (70–80%) than in men (20–30%).

Biofilm is defined as an accumulation of microorganisms and their extracellular products that form a structured community on a solid surface. Biofilms are ubiquitous. In the context of urological practice they can be demonstrated on catheters, drainage bags and other foreign bodies and prostheses.

Biofilm is composed of three layers: (i) the linking film, attached to the surface tissue or biomaterial; (ii) the basal layer; and (iii) the surface film adjacent to the lumen, from which planktonic organisms can be released. Organisms within the biofilm are well protected from mechanical flushing by urine flow, other host defences and antibiotics. Bacteria with specialized structures like fimbriae and pili are more prone to cause urinary tract

infection. Conventional laboratory testing can easily detect planktonic free-floating bacteria within the urine or occasionally in the tissue. However, sessile pathogens from the biofilm will not be detected with routine methods.

Microorganisms in catheter associated urinary tract infection

The most common infecting organisms in catheter associated urinary tract infection are the Enterobacteriaceae. In most reports, Escherichia coli is the most common organism isolated from women, and Proteus mirabilis is the most frequent in men. Recently three studies have proven that Klebsiella pneumoniae is the most common organism in catheter associated urinary tract infection. Other organisms frequently isolated include Citrobacter species, Enterobacter species, Serratia species, Providencia stuartii, Morganella morganii, and Pseudomonas aeruginosa. Enterococcus species and group B streptococci are the most frequently isolated gram-positive organisms, and Candida species also may cause infection. Polymicrobial bacteriuria is identified in 10% to 25% of both men and women. Organisms isolated from urinary tract infection tend to have increased antimicrobial resistance relative to those isolated from elderly subjects in the community. This observation reflects repeated exposure to antimicrobials in a given individual with recurring infection, as well as the intense use of

antimicrobials in catheter associated urinary tract infection, together with opportunities for transmission of organisms among patients. Providencia stuartii is one organism that may be highly resistant and appears to have a unique institutional predilection.

Symptoms

Symptoms are also not reliable for the diagnosis of catheter-associated urinary tract infection. Most catheter-associated urinary tract infections are asymptomatic. Part of the reason for the absence of symptoms of urethral irritation such as dysuria or supra-pubic pain is that the catheter itself prevents contact of inflammatory cells in urine and large numbers of microorganisms with the urethral mucosa. The presence of the urinary catheter in situ also allows for decompression of the bladder, thus preventing the development of symptoms related to bladder distension or reflux. It is interesting to note that the majority of cases of bloodstream infection and mortality associated with catheter-associated urinary tract infections are in patients where there is significant urinary obstruction. It has also been shown that patients with long-term indwelling catheters rarely have febrile episodes even though they have chronic significant amounts of bacteria in their urine. This changes when obstruction or encrustation occurs as in that setting, decompression of the infected bladder is compromised.

Methods of catheterisation and the risk of urinary tract infection

Single (straight) catheterisation

After single (straight) catheterisation, bacteriuria develops in 1–5% of cases. The risk of infection is increased in female patients, patients with urinary retention, in peripartum catheterisation, in men with prostatic obstruction, in diabetes mellitus and in debilitated and elderly patients.

Short-term catheterisation

Short-term catheterization is usually defined as catheter in place for less than 7 days. Indications for short-term bladder catheterisation are to monitor urine output (i) in acutely ill patients, (ii) for urinary obstruction and (iii) in the perioperative period. Between 15% and 25% of patients admitted to hospital may be catheterised for 2–4 days during their stay. Between 10% and 30% will develop bacteriuria.

Most episodes of short-term catheter-associated bacteriuria are asymptomatic and are caused by single organism; 15% may be polymicrobial, reflecting the prevailing flora in hospital or community environments. Therefore, the most common species are Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis, Staphylococcus epidermidis, Enterococcus and Candida. Most catheter-

associated bacteriuria is accompanied by pyuria which however varies by organism.

Although there is extensive literature on the type, maintenance and techniques for the insertion of urinary catheters, little attention is paid to their removal. The importance of short-term urethral catheter management is recognised; however, there is no consensus about the optimal time and method for removal of indwelling urethral catheters. Fewer urinary tract infections occurred when the catheter was removed as soon as possible.

Long-term catheterisation

When indwelling catheterization lasts for more than 28 days it is defined as ‘long-term’ or ‘chronic’. Unfortunately, there is no consensus on the classification of indwelling catheters in place for 8-27 days. The commonest infecting organism is Escherichia coli. Persistence is related to the presence of type 1 pili, an adhesin for uroepithelium and the Tamm–Horsfall protein. Other associated flora includes Pseudomonas, Proteus, Morganella, Acinetobacter, Enterococcus and Candida. Bacteriuria is polymicrobial in up to 95% of urine specimens from long-term catheterised patients. One- quarter of organisms in catheter urine are not present in urine simultaneously obtained by suprapubic bladder puncture, suggesting that some organisms colonize the catheter only.

Transient asymptomatic bacteraemia is common during initial catheter insertion or during catheter exchange in chronically catheterised patients. The relatively low incidence of febrile urinary tract infection and bacteraemia may be due to the fact that colonization of urethral catheters is caused mainly by less virulent organisms. It has been shown that colonizing Escherichia coli strains lack P fimbriation in a catheter-associated infection.

The contribution of catheter-associated urinary tract infection to mortality is unclear. The contributable mortality varies between 9% and 13%. Other risk factors include severity of co-morbid disease, inappropriate antibiotic therapy, remote infection and the presence of an unrecognised urological abnormality. Chronic catheterisation can lead to obstruction of the lower urinary tract owing to catheter blockage as well as to urinary tract stones, epididymitis and prostatitis. Up to 50% of patients undergoing catheterisation for more than 28 days experience recurrent encrustation and catheter blockage. Intermittent urinary retention can lead to vesicoureteric reflux and ascending complicated infection. Infecting organisms often include Proteus mirabilis, a potent urease producer, which promotes the development of struvite stones by hydrolysis of urea to ammonium. Bladder catheterisation for more than 10 years, e.g. in patients with spinal cord injury, may be associated with an increased risk of bladder cancer [51].

Alternative methods of urine drainage

Prevention of catheter associated infection may be accomplished by alternatives to indwelling catheterisation.

Intermittent catheterisation

Intermittent catheterisation [48] is popular in the management of voiding dysfunction due to a wide variety of causes, including a neuropathic bladder. It is a safe and effective method of bladder management for four groups of patients: children with neuropathic bladder dysfunction (e.g. spina bifida); women with incontinence caused by uncontrolled reflex detrusor contraction; women and men with urinary retention due to ineffective or absent detrusor contraction; and males with bladder outlet obstruction who are not fit for surgery. Bacteriuria is acquired at the rate of 1–3% per catheterisation. Therefore it is universal by the end of the third week. It may be expected that local periurethral infection, febrile episodes, stones and deterioration of renal function are less common than in patients permanently catheterised. Complications include bleeding, urethral inflammation, stricture, false passage, epididymitis, bladder stone and hydronephrosis.

Suprapubic catheterisation

Suprapubic catheterisation [19] is used mainly in patients undergoing urological or gynaecological procedures. According to the several studies

there is evidence that suprapubic catheters are superior to indwelling urethral catheters in terms of bacteriuria (asymptomatic and symptomatic) and re-catheterisation.

Condom catheters

Condom catheters [47] can be useful in male patients without outlet obstruction. However, condom drainage may be unsatisfactory in confused or uncooperative patients or where there is obesity or a short penis. Skin maceration and ulceration can occur. Daily changing of the condom catheter is recommended, although changes every other day are not associated with increased infection rates. Condom catheters offer a lower incidence of bacteriuria compared with long-term urethral catheterisation.

Urethral stents and prostheses

Urethral stents and prostheses are often inserted into the prostatic urethra for a variety of indications, including neurogenic bladder dysfunction, prevention of strictures, and treatment of urinary retention. Bacteriuria, which is usually asymptomatic, occurs in 10–35% of patients.

Advantages and disadvantages of various catheter modalities for drainage purposes

Procedure	**Advantages**	**Disadvantages**
Transurethral indwelling catheter	-catheters with several luminal sizes. -special catheters for flushing the bladder and for permanent bladder irrigation. - Catheter insertion usually not very traumatic using optimal technique. - only few contraindications, e.g. urethral stricture, urethral trauma	-local infection (Urethritis) -urethral trauma, stricture and paraurethral abscess -prostatitis, epididymitis, pyelonephritis, urosepsis -high rate of nosocomial urinary tract infection -residual urine measurement not possible
Intermittent catheterisation	-less local periurethral infection, febrile episodes, stones and deterioration of renal failure -clean catheterization	-elevated urethral trauma -urethral stricture -false passage -Urethritis, epididymitis, prostatitis -cooperative and skilled patient -difficult process in men
Suprapubic catheter	-no Urethritis, prostatitis, epididymitis -no Urethritis, prostatitis, epididymitis -lower rate of nosocomial UTI -spontaneous micturition and residual urine measurement -transurethral diagnostic procedures, cystoscopy, urethrogramme	-installation by physician -Relative contraindications -bladder shrinkage -suprapubic scars -meteorism -pregnancy -obesity -Absolute contraindications: – bladder volume <200 ml

	-less troublesome for the patient	– bladder tumor –anticoagulation therapy, haemorrhagic tendency, gross haematuria – skin diseases in the puncture area
Condom catheter	-lower incidence of bacteriuria -no urethritis, prostatitis, epididymitis -no urethral stricture -less painful procedure	-cooperative and skilled patient – obesity – short penis – skin maceration and ulceration
Urethral stent/prosthesis	-lower incidence of bacteriuria -less urethral stricture -less troublesome for the patient	-difficulty in proper placement, changing or removal -high level of scar formation -secondary stricture calcification

RISK FACTORS FOR CATHETER ASSOCIATED URINARY TRACT INFECTION

The most important risk factors have been prolonged catheterization and females are more at risk for catheter associated urinary tract infection. Other risk factors identified have included catheterization outside the sterile environment of the clinical room, patients with urinary tract abnormality, other infections, diabetes, malnutrition and renal failure. Interestingly, most

of the infection control interventions were found to have a minimal impact on the incidence of catheter associated urinary tract infection with one exception – if the drainage tube was allowed to be above the level of the patient; that was a major risk factor for infection. Antibiotics were in general protective, but the infections (when they occurred) tended to be caused by antibiotic-resistant organisms.

Risk factors for catheter associated urinary tract infection based on a study by Dennis G. Maki and Paul A. Tambyah Emerging Infectious Diseases Vol. 7, No. 2, March–April 2001

Factor	Relative risk
Prolonged catheterization >6 days	5.1-6.8
Female gender	2.5-3.7
Catheter insertion outside operating room	2.0-5.3
Other active sites of infection	2.3-2.4
Diabetes	2.2-2.3
Malnutrition	2.4
Azotemia (creatinine >2.0 mg/dL)	2.1-2.6
Urethral stent	2.5
Monitoring of urine output	2.0
Drainage tube below level of bladder and above collection bag	1.9

GUIDELINES FOR PREVENTING CATHETER ASSOCIATED URINARY TRACT INFECTION

Several catheter care practices are universally recommended to prevent or at least delay the onset of catheter associated urinary tract infection: avoid unnecessary catheterizations; consider a condom or suprapubic catheter; have a trained professional insert the catheter aseptically; remove the catheter as soon as no longer needed; maintain uncompromising closed drainage; ensure dependent drainage; minimize manipulations of the system; separate catherised patients; and consider adopting a novel anti-infective catheter. However, few of these practices have been proven to be effective by randomized controlled trials.

Avoid Unnecessary Catheterizations

Use of indwelling urethral catheters should be limited to patients [62] requiring relief of anatomic or physiologic outlet obstruction; patients undergoing surgical repair of the genitourinary tract (to facilitate healing); critically ill or postoperative patients who need their urinary output accurately measured; and debilitated, paralyzed, or comatose patients (to prevent skin breakdown and infected pressure ulcers). When no longer needed, the catheter should be promptly removed.

Consider Alternatives to Urethral Catheterization

Suprapubic catheterization is more comfortable and acceptable to the patient and may be associated with a lower incidence of catheter associated urinary tract infection. For incontinent males who do not have bladder outlet obstruction, condom drainage, while not free from nosocomial urinary tract infections, appears to be associated with a lower risk than indwelling urethral catheters.

Insertion Using Aseptic Technique

Catheters should be inserted by trained health-care professionals using aseptic technique, including sterile gloves, a fenestrated sterile drape, and an effective cutaneous antiseptic, such as 10% povidone-iodine or 1% to 2% aqueous chlorhexidine.

Closed Drainage

After a catheter is inserted, uncompromising maintenance of closed drainage is of the highest priority and can keep the overall risk of catheter associated urinary tract infection <25% for up to 2 weeks of catheterization.

Ensure Dependent Drainage

The collection tubing and bag should always remain below the level of the patient's bladder, but the drainage tubing should always be above the level of the collection bag.

Urine Collection

The catheter and the drainage system should be manipulated as little as possible, and urine output should be monitored hourly, only when clearly indicated by the patient's condition.

Other Practices

If feasible, separating catheterized patients geographically on a patient-care unit may reduce the risk of cross infection with multidrug-resistant nosocomial organisms such as Serratia, Klebsiella, Pseudomonas, and Enterobacter. Systemic antimicrobial prophylaxis with trimethoprim-sulfamethoxazole, methenamine mandelate or a fluoroquinolone can reduce the risk of catheter associated urinary tract infection for short-term catheterizations. Although use of antimicrobials in this way may reduce the rate of catheter associated urinary tract infections, infections that do occur are far more likely to be caused by antibiotic-resistant bacteria and yeasts. Since most catheter associated urinary tract infections are asymptomatic and do not result in urosepsis, it is difficult to justify antimicrobial therapy of asymptomatic bacteriuria other than for granulocytopenic or other severely immunocompromised patients, patients scheduled for urologic surgery, pregnant women, patients with Serratia catheter associated urinary tract infection, or patients about to have their catheter removed. The societal

benefits of antibiotic prophylaxis in immunocompetent catheterized patients to prevent largely asymptomatic catheter-associated urinary tract infection are dubious.

Silver-coated catheters

Silver [16] is a well-known antiseptic with a long history, as an antiseptic rather than an antibiotic and the risk of generating antibiotic resistance would be expected to be low. Argyrism is a potential concern that has limited the use of silver on the internal coating of catheters and possibly limited its efficacy. There are a number of studies that have evaluated silver coated catheters [17] including silver oxide catheters and silver alloy catheters. Though there is a controversy in the efficiency of silver oxide catheters a meta-analysis of silver alloy coated catheters suggests that they are beneficial.

Antibiotic coated catheters

Antibiotic coated catheters using a combination of rifampicin and minocycline have been used. The rifampicin-minocycline catheter was most effective in preventing catheter associated urinary tract infection caused by Gram-positive rather than Gram-negative bacteria thus limiting its practical efficacy. The concern has been in the development of antibiotic resistance. In many parts of the world, where Mycobacterium tuberculosis is endemic,

as in our country the widespread use of rifampicin coated catheters would be a cause for concern, if this was found to be associated with increased rates of drug-resistant tuberculosis.

Silicone urinary catheter impregnated with chlorhexidine and triclosan:

Silicone urinary catheter impregnated with chlorhexidine and triclosan [55] show prolonged efficacy against colonization with important uropathogens including drug resistant bacteria and Proteus mirabilis. This catheter may suppress the growth of pathogens associated with long-term catheterization, with a reduced risk of emergence of resistant organisms

Novel Technology

Technologic innovations to prevent nosocomial infection are most likely to be most effective if they are based on a clear understanding of the pathogenesis and epidemiology of the infection. Novel technologies must be designed to block catheter-associated urinary tract infection by either the extraluminal or intraluminal routes or both. Technologic innovations have been proposed and evaluated during the past 25 years but have not proven conclusively beneficial. Among these innovations are using anti-infective lubricants when inserting the catheter; soaking the catheter in an anti-infective antimicrobial-drug solution before insertion; regular metal cleansing or periodically applying anti-infective creams or ointments to

metals; continuously irrigating the catheterized bladder with an anti-infective solution through a triple-lumen catheter; or periodically instilling an anti-infective solution into the collection bag. Bladder irrigation with antimicrobial drug solutions has not only shown no benefit for prevention but has been associated with a strikingly increased proportion of catheter-associated urinary tract infections caused by microorganisms resistant to the drugs in the irrigating solution. Given the widely accepted importance of closed catheter drainage, efforts have been made to seal the connection between the catheter and collection tubing.

Medicated catheters [35], which reduce adherence of microorganisms to the catheter surface, may confer the greatest benefit for preventing catheter-associated urinary tract infection. Two catheters impregnated with anti-infective solutions have been studied in randomized trials, one impregnated with the urinary antiseptic nitrofurazone [57] and the other with a new broad spectrum antimicrobial-drug combination [56], minocycline and rifampin. Both catheters showed a significant reduction in bacterial catheter-associated urinary tract infections.

The universal presence of a biofilm on the surface of an infected catheter has prompted hope that coating the catheter surface with an antiseptic, such as a silver compound, might reduce the risk for catheter

associated urinary tract infection. However, silver oxide coated catheters, which had been initially reported to show promise, did not show efficacy when studied in large, well controlled trials. In one of the trials, male patients with the coated catheter who did not receive systemic antibiotics had a paradoxical and inexplicably increased risk for catheter-associated urinary tract infection. A silver hydrogel catheter has been developed that inhibits adherence of microorganisms to the catheter surface in vitro and the tested microorganisms include resistant enterococci, staphylococci, Enterobacteriaceae, Pseudomonas aeruginosa, and yeasts. Use of the silver hydrogel catheter was not associated with an increased incidence of infections caused by antibiotic resistant bacteria or Candida, and in vitro susceptibility testing of isolates from both treatment groups showed no infections caused by silver resistant microorganisms. Cost utility analysis indicates that use of this catheter could bring substantial cost savings to health care institutions.

Treatment

Treatment of asymptomatic bacteriuria

Generally, asymptomatic bacteriuria should not be treated because bacteriuria will either not be eradicated or will return rapidly. However, antimicrobial therapy may contribute to the selection of resistant organisms

and to adverse reactions. There is no evidence that antimicrobial therapy decreases morbidity or mortality from urinary tract infection in catheterized patients, therefore systemic antimicrobial treatment of asymptomatic catheter associated bacteriuria is only recommended in the following circumstances:

(i) patients undergoing urological surgery or implantation of prostheses;

(ii) treatment may be part of a plan to control nosocomial infection due to a particularly virulent organism prevailing in a treatment unit;

(iii) patients who have a high risk of serious infectious complications, e.g. patients who are immunosuppressed; and

(iv) infections caused by strains causing a high incidence of bacteraemia, e.g. Serratia marcescens.

If the catheter drains properly, routine urine cultures in asymptomatic catheterised patients are also not recommended because treatment generally is not necessary. Also, it has not been shown that an uropathogen cultured from an asymptomatic patient will be the causative organism when a symptomatic episode occurs. Following catheter removal in one-third to one-half of cases, the urinary tract will clear bacteria spontaneously. Spontaneous clearance occurs more commonly in women under 65 years of

age or when Staphylococcus epidermidis is the infecting organism. However, one study shows that elderly females may need treatment if bacteriuria does not resolve spontaneously or if symptomatic infection occurs.

Treatment of symptomatic urinary tract infection:

The most frequent clinical manifestation of symptomatic urinary tract infection in catheterised residents is fever. Some patients may also become septic with at least two of the followings symptoms: hypothermia, tachycardia (> 90/min), tachypnoea (>20/min and/or pCO2 <33 Hg mm), leucocytosis (>12/nl) or leucopenia (<4/nl). Since patients with long-term indwelling catheters always have positive urine cultures, a definite diagnosis of the source of infection remains problematic in a febrile or septic catheterized patient without localizing genitourinary symptoms and if not bacteraemic due to the same urinary pathogen. Urinary tract infection may be the source of fever; if there are no localising features such as obstruction, haematuria or costovertebral angle tenderness, alternative diagnoses must be considered. Observation, rather than immediate antimicrobial therapy, should be considered when the patient is clinically stable and the fever is of low grade.

Antibiotic treatment is recommended only in symptomatic infection (bacteraemia, pyelonephritis, epididymitis, and prostatitis). Systemic antibiotics should be used for catheterised patients who are febrile and appear to be ill, because of the possibility of urinary tract infection related bacteraemia or pyelonephritis. Owing to the likelihood of bacteria sequestered in a biofilm on the catheter surface, it may be reasonable to replace or remove the catheter if the indwelling catheter has been in place for more than 7 days before the therapy of symptomatic catheter-associated bacteriuria. After initiation of empirical treatment usually with broad-spectrum antibiotics based on local susceptibility patterns, the choice of antibiotics may need to be adjusted according to urine culture results. Therefore, urine culture and in septic patients also blood culture, must be taken before any antibacterial therapy is started. Although there are no adequate clinical studies to guide the length of therapy for catheter related symptomatic urinary tract infection, antimicrobial treatment usually varies from 5 days to 21 days depending on the organism, co-morbid conditions and patient response. Chronic antibiotic suppressive therapy is not effective and generally not recommended. Catheterized urine cannot be permanently sterilised. Occasionally, the culture shows candiduria, which is usually asymptomatic and often resolves without treatment. In this case neither

systemic nor local (bladder irrigation) antifungal therapy is indicated, but removal of the catheter or stent should be considered. If the infection is associated with urinary symptoms or candiduria is the sign of a systemic infection, systemic therapy with antifungals is indicated.

Prevention of cross-infection

Healthcare workers should be constantly aware of the risk of cross-infection between catheterised patients. They should observe protocols on hand washing and the need to use disposable gloves. The periurethral bacterial flora, surfaces of the catheter system and the persistent, huge reservoir of contaminated urine as well as the skin of the patient are sources for contamination of the hands of medical personnel who may carry the bacteria to other patients. This may be reduced by treating the catheterised urinary tract as an open wound. It is therefore essential to use gloves after hand washing in antiseptic solutions.

The Future

The first major advance for preventing catheter associated urinary tract infection since the wide scale adoption of closed drainage 35 years ago, is the development of catheters with anti-infective surfaces. These advances should not be considered as the final answer, however. Other technologies that should be pursued include new, more potent anti-infective materials;

microbe-impervious antireflux valves; urethral stents; conformable (collapsible) urethral catheters; and vaccines for enteric gram-negative bacilli and staphylococci. Antiseptics are far more likely than antibacterials to confer greater resistance to surface colonization and not to select for infection with antimicrobial drug resistant bacteria or yeasts**.** New surface technologies that release far greater quantities of ionic silver or other anti-infective agents into the aqueous environment contiguous to the catheter surface might even prevent catheter associated urinary tract infections caused by intraluminal contaminants. In uncontrolled trials, urethral stents have provided a less-invasive alternative to catheter drainage for men with outlet obstruction caused by prostatic hypertrophy or cancer. A conformable catheter, with a collapsible intraurethral segment that may cause fewer traumas to the urethra, has been developed but has not been tested clinically and is not commercially available. These and other alternatives to the rigid urethral catheter, such as a condom catheter for female patients, need to be evaluated in controlled, randomized trials. The greatest hope for a major reduction in catheter associated urinary tract infections and indeed all nosocomial infections is likely to be vaccines against important nosocomial multidrug-resistant pathogens, such as the enteric gram-negative bacilli and staphylococci.

MATERIALS AND METHODS

This study was conducted in Government Stanley Hospital. The study was conducted over a period of nine months from December 2007 to August 2008.

Patients who were catheterized for various disease conditions were taken for study. The patients were mainly from surgical wards like general surgery, orthopedics, neurosurgery and medical wards like neuromedicine, general medicine and intensive care unit. The patients were included in the study after getting informed consent from them or from their relatives. The primary diagnosis for which they were admitted was noted.

Both males and females in age group of 20 to 70 years were included in our study. A total of 208 patients of which 105 were males and 103 were females were initially included in our study. 98 patients of which 48 were males and 50 were females were excluded from the study based on the exclusion criteria and finally a total of 110 patients were included in the study for analysis.

INCLUSION CRITERIA:

Long term catheterized patients like:

1. Fracture femur.

2. Dislocation of hip.

3. Traumatic and other causes of paraplegia.

4. Cerebrovascular accidents.

5. Neurodegenerative disorders.

6. Various types of meningitis.

7. Various types of encephalopathies.

EXCLUSION CRITERIA:

1. Patients who were urine culture and sensitivity positive on the day of catheterization.

2. Patients in whom catheter was removed before the fourth day for various reasons like the patient's general condition improved or the patient absconded from ward or went against medical advice or died.

3. Patients in whom catheter was removed before the eight day and was urine culture and sensitivity negative on the fourth day for various reasons like the patient's general condition improved or the patient absconded from ward or went against medical advice or died.

4. Patients who had symptoms suggestive of urinary tract obstruction and elderly male patients with prostatic hypertrophy and female patients with ultrasonographic evidence of pelvic inflammatory diseases and symptoms suggestive of atrophic vaginitis.

A complete history and physical examination of the patients were made and the details recorded. Any previous history of chronic diseases like diabetes mellitus, hypertension, cardiac diseases, previous history of catheterisation or any other diseases was elicited and the details recorded. Blood samples were taken and sent for various analysis like blood sugar, urea, serum creatinine, serum electrolytes and complete blood count. Ultrasonogram of abdomen was also done and the findings recorded.

After ensuring strict aseptic precautions urinary bladder was catheterised using adult size Foley's catheter. The first drained urine sample was collected directly from the rubber tubing end, and sent for routine urine analysis and for culture and sensitivity and the reports were taken for analysis.

On day four of catheterization, patients were examined for general physical status and history of fever, dysuria and abdominal pain was made and the details were recorded. Then urine sample was collected directly from the catheter after disconnecting from the draining tube and the sample was

sent for routine urine analysis and culture and sensitivity and the reports noted. Urine samples which showed organism growth of over 10^3 were considered significant and was reported positive by the microbiologist and drug sensitivity pattern for those samples were made and reported. The reports were then taken for our study analysis.

A similar urine sample was collected on the eight day if the urine culture and sensitivity report on the fourth day was culture negative and the sample was sent for similar analysis as on the fourth day. The reports were then taken for our study analysis.

All the data were recorded in the master chart and the reports were then taken for analysis.

RESULTS

A total of 208 patients of which 105 were males and 103 were females were initially included in the study.

The number of patients excluded was 98 of which 48 were males and 50 were females. The details of exclusion are:

Table I - Exclusion details of patients

Exclusion details	Male	Female	Total
Urine culture positive on first day	4	7	11
Catheter removed before fourth day a. Patient improved b. Against medical advice c. Patient died	 11 2 5	 10 3 2	 21 5 7
Catheter removed before eight day when urine culture negative on fourth day a. Patient improved b. Against medical advice c. Patient died	 14 3 4	 18 6 3	 32 9 7
Patients with symptoms of urinary tract obstruction	5	1	6
Final total	48	50	98

Table II - Number of patients in the study

Patients initially included in study	208
Patients excluded from study	98
Total patients finally included in the study	110

Of the 110 patients, 105 were males constituting 52% and 103 were females constituting 48%.

The patients included in the study were in the age group of 25 years to 68 years with an average of 50 years.

Table III - Age wise distribution of patients

Age (Years)	**Number of patients**
25 - 35	6
36 - 45	25
46 - 55	43
56 - 65	26
66 - 75	2

Table IV - Indications for catheterization

Diagnosis	Number of patients
Cerebrovascular accident	16
Neurodegenerative diseases	10
Encephalopathy	11
Meningitis	10
Transverse myelitis	6
Compressive myelopathy	8
Fracture femur	12
Fracture leg	8
Hip dislocation	8
Traumatic paraplegia	8
Bowel anastamosis	9
Abdominal surgery	4

Among the 110 catheterized patients, 31 patients were urine culture and sensitivity positive on day 4 of catheterization constituting 28%and the remaining 79 patients were urine culture and sensitivity negative constituting 72% .Of these 31 urine culture and sensitivity positive patients 14 were males and 17 were females.

Among 79 patients who were urine culture and sensitivity negative, 14 patients became urine culture and sensitivity positive on day 8. It constituted 41% of the total 110 patients. Among the 14 patients 6 were males and 8 were females. The percentage of increase in urine culture and sensitivity positivity from day 4 to day 8 was 18%.

Table V – Urine culture reports

Days of catheterisation	**Urine culture and sensitivity positive Number (%)**	**Urine culture and sensitivity negative Number (%)**
At the end of day 4 of catheterization	31 (28%)	79 (72%)
At the end of day 8 of catheterization	45 (41%)	65 (59%)
From day 4 to day 8 of catheterization	14 (18%)	65 (82%)

Table VI - Sex wise distribution of Urine culture positive patients

Urine culture positive	Male	Female
Urine culture and sensitivity positive on day 4 Number (%)	14 (45%)	17 (55%)
Urine culture and sensitivity positive on day 8 Number (%)	20 (44 %)	25 (56%)
Urine culture and sensitivity positive from day 4 to day 8 Number (%)	6 (43%)	8 (57%)

Among the 57 male patients 14 were urine culture and sensitivity positive on day 4 and 20 were urine culture and sensitivity positive on day 8. Among the 53 female patients 17 were urine culture and sensitivity positive on day 4 and 25 were urine culture and sensitivity positive on day 8.

Table VII - Sex wise risk for urine culture positivity

Description	Male Number (%)	Female Number (%)
Total patients in study	57 (52%)	53 (48%)
Incidence of urine culture positivity on day 4 of catheterization	14 (25%)	17 (32%)
Incidence of urine culture positivity on day 8 of catheterization	20 (35%)	25 (52%)

Among the 31 urine culture positive isolates on day 4, 11 were Klebsiella pneumonia positive, 9 were Escherichia coli positive, 4 were Enterococci positive, 3 were Pseudomonas positive, 2 were Staphylococcus aureus positive, 2 were coagulase negative staphylococci positive.

Among the 45 urine culture positive isolates at the end of day 8, 15 were Klebsiella pneumonia positive, 13 were Escherichia coli positive, 5 were Enterococci positive, 4 were Pseudomonas positive, 4 were Staphylococcus aureus positive, 3 were coagulase negative staphylococci positive and in 2 samples there was growth of Candida.

Table VIII - Distribution of microorganisms in urine culture positive isolates

Organism grown	On the fourth day urine sample (Total = 31) Number (%)	At the end of eighth day urine sample (Total = 45) Number (%)
Klebsiella pneumonia	11 (36%)	15 (33%)
Escherichia coli	9 (29%)	13 (29%)
Enterococci	4 (13%)	5 (11%)
Pseudomonas	3 (10%)	4 (9%)
Staphylococcus aureus	2 (6%)	4 (9%)
Coagulase negative staphylococci	2 (6%)	3 (7%)
Candida	0	1 (2%)

In our study, Klebsiella pneumoniae was the most common organism isolated constituting 33%, followed second by Escherichia coli constituting 29% and third by Enterococci constituting 11%. Candida constituted 2% of microorganism isolate in our study.

Klebsiella pneumoniae that was isolated in the urine sample was sensitive to amikacin in 14 cases and resistant in 1 case, sensitive to gentamicin in 9 cases and resistant in 6 cases, sensitive to ciprofloxacin, norfloxacin, cefotaxime, cotrimoxazole in 6 cases and resistant in 9 cases and sensitive to erythromycin in 1 case resistant in 14 cases.

Escherichia coli was sensitive to amikacin in 13 cases, sensitive to gentamicin and ciprofloxacin in 11 cases and resistant in 2 cases, sensitive to norfloxacin in 10 cases resistant in 3 cases, sensitive to erythromycin in 8 cases resistant in 5 cases, sensitive to cefotaxime in 9 cases and resistant in 4 cases and sensitive to cotrimoxazole in 6 cases and resistant in 7 cases.

An important finding in our study was that almost all of the patients included in the study were put on some form of antibiotic like ampicillin, gentamicin, ciprofloxacin and cefotaxime from the first day of catheterization. But still there was occurrence of catheter associated urinary tract infection in the range of 45% at the end of eight day of catheterization.

Table IX - Drug sensitivity pattern for Klebsiella pneumoniae and Escherichia coli in our study

Antibiotic	Klebsiella pneumoniae (Total = 15) Number (%)		Escherichia coli (Total = 13) Number (%)	
	Sensitive	Resistant	Sensitive	Resistant
Amikacin	14 (93%)	1 (7%)	13 (100%)	0
Gentamicin	9 (60%)	6 (40%)	11 (85%)	2 (15%)
Ciprofloxacin	7 (47%)	8 (53%)	11 (85%)	2 (15%)
Norfloxacin	6 (40%)	9 (60%)	10 (77%)	3 (23%)
Cefotaxime	6 (40%)	9 (60%)	9 (69%)	4 (31%)
Erythromycin	1 (7%)	14 (93%)	8 (61%)	5 (39%)
Cotrimoxazole	6 (40%)	9 (60%)	6 (46%)	7 (54%)

This shows that amikacin was the antibiotic which was sensitive to most number of Klebsiella pneumoniae and Escherichia coli in our study.

Similarly these organisms were resistant to a high proportion to the commonly used antibiotics like erythromycin and cotrimoxazole.

Among 31 patients who were urine culture positive on day 4, 28 were asymptomatic and 3 patients presented with symptoms like fever, abdominal pain, dysuria. Among 45 patients who were urine culture positive at the end of eight day 39 were asymptomatic and 6 presented with symptoms.

Table X – Symptomatology of urine culture positive patients

Urine culture positivity	**Asymptomatic patients Number (%)**	**Symptomatic patients Number (%)**
On day 4 of catheterization (Total = 31)	28 (91%)	3 (9%)
At the end of the eight day of catheterization (Total = 45)	39 (87%)	6 (13%)

In our study, there were 14 diabetes mellitus patients based on history and fasting blood glucose level of more than 126 milligram per deciliter and postprandial blood glucose level of more than 200 milligram per deciliter. Out of these 14 diabetic patients, 8 were urine culture positive for microorganisms and 6 were urine culture negative. Out of the remaining 96 non diabetic patients, 37 were urine culture positive for microorganisms and 59 were urine culture negative.

Risk of catheter associated urinary tract infection among diabetics in our study was 57%.

Risk of catheter associated urinary tract infection among non diabetics in our study was 39%.

Among the 110 patients 32 patients had ultrasonographic evidence of renal calculi but all of these patients were without any symptom suggestive of renal calculi like characteristic loin pain, oliguria and azotemia. Out of these 32 renal calculi patients, 18 were urine culture positive for microorganisms and 14 were urine culture negative. Out of the remaining 78 patients without renal calculi, 27 were urine culture positive for microorganisms and 51 were urine culture negative

Risk of catheter associated urinary tract infection among renal calculi patients in our study was 53%.

Risk of catheter associated urinary tract infection among patients without renal calculi in our study was 34%.

DISCUSSION

Urinary tract infection (UTI) is the most common nosocomial infection with catheterization constituting the most frequent cause. Eighty percent and in some studies all of nosocomial urinary tract infections were associated with Foley's catheter.

This study was undertaken to analyse the incidence, sex risk, microbiological pattern, drug sensitivity, symptomatology, the influence of the days of catheterization, the influence of the associated co-morbid conditions in producing urinary tract infections in patients catheterized in Government Stanley Hospital.

In this study 110 patients of which 57 were males and 53 were females were included. The most common indication for which the bladder was catheterized was Cerebrovascular accidents followed by neurodegenerative disorders.

Among the 110 patients, 31 patients were urine culture positive on day three of catheterization. It constituted 28% of urine culture positive cases. This was consistent with the studies done by Tambyah et al where it was 30% and Henry Alaveran et al where it was 26%.

At the end of day eight there were 45 urine culture positive patients. It constituted 41% of the total 110 patients. There was an increase by 18%

from day 4 to day 8 of catheterization. This was consistent from the studies by Somwang et al and Henry Alaveran et al where the risk of infection increased by 3 to 5% for each day of catheterisation.

Among the 31 urine culture positive patients on day 4, 14 were males constituting 45% and 17 were females constituting 55%. Among the 45 urine culture positive patients at the end of day 8, 20 were males constituting 44% and 25 were females constituting 56%. The incidence of urinary tract infection among males in our study was 32% and that in females was 52%. This was consistent with studies done by Somwang et al and Tambyah et al which showed that females have a higher risk for catheter associated urinary tract infection.

In most of the studies like Herbert et al, Tambyah et al the commonest organism producing catheter associated urinary tract infection was Escherichia coli followed by Klebsiella pneumoniae. The most common organism producing catheter associated urinary tract infection in our study was Klebsiella pneumoniae (33%) followed by Escherichia coli (29%) and Enterococci (11%). A similar result was obtained in studies done by M. Sharifi et al in Iran and Tangtrakul et al in Thailand which showed that Klebsiella pneumoniae was commoner than Escherichia coli in catheter associated urinary tract infection.

In our study, the common organisms like Klebsiella pneumoniae and Escherichia coli were resistant at a high percentage to the commonly used antibiotics like erythromycin (93 %) and cotrimoxazole (60%). This was consistent with the studies done by Gupta K et al and Talan DA et al where there was increased resistance to the commonly used antibiotics.

In our study, amikacin was sensitive to greater percentage of Klebsiella pneumoniae (93%) and Escherichia coli (100%). This was consistent with the studies done by Stickler DJ et al and the details of bacteriological spectrum for amikacin in Katzung text book of Pharmacology.

In our study 87% of the 45 urine culture positive patients were asymptomatic. This was consistent with study by Tambyah et al where more than 90% of catheter associated urinary tract infection patients were asymptomatic.

In our study all the patients were put on antibiotics from day one of catheterization. But still the risk of urinary tract infection in catheterized patients was 41% which was consistent with studies where the risk of infection was around 30% without any prophylactic antibiotics. This shows that there is no role for prophylactic antibiotics in catheter associated urinary tract infection. This was consistent with studies done by Warren JW et al

and Tambyah et al which showed that there was no role for prophylactic antibiotics in catheter associated urinary tract infection

In our study the risk of catheter associated urinary tract infection in diabetes mellitus patients (57%) were more than the non diabetic patients (39%). Similarly the risk of catheter associated urinary tract infection in patients with renal calculi (53%) was more than the patients with out renal calculi (34%). This was consistent with studies done by Raz R et al and Ley WC et al where they showed increased risk of catheter associated urinary tract infection in diabetic and renal calculi patients.

CONCLUSION

THE PRESENT STUDY INDICATES

1. Urinary tract infection is common in catheterized patients.
2. The risk of catheter associated urinary tract infection increases with the days of catheterization.
3. Females were more at risk for catheter associated urinary tract infection than males.
4. Klebsiella pneumoniae was commoner than Escherichia coli in producing catheter associated urinary tract infection in this study.
5. There was increased resistance of catheter associated urinary tract infections to the commonly used antibiotics.
6. Amikacin was sensitive to most of the catheter associated urinary tract infections.
7. Most of the catheter associated urinary tract infection patients were asymptomatic.
8. There was no role for prophylactic antibiotics in preventing catheter associated urinary tract infections.
9. Patients with risk factors like diabetes mellitus and renal calculi were more at risk for catheter associated urinary tract infections.

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PROFORMA

Name	**Age**	**Sex**
Complaints	**Yes**	**No**
Fever		
Dysuria		
Loin pain		
Comorbid conditions	**Yes**	**No**
Diabetes mellitus		
Renal calculi		
Renal failure		
Others		

Diagnosis for which admitted

Current antibiotics (if any)

Investigations

Blood	**Others**
Total count	Chest X ray
Differential count	Abdominal X ray
ESR	Electrocardiogram
Haemoglobin	Ultrasonogram abdomen
Sugar	
Urea	
Creatinine	

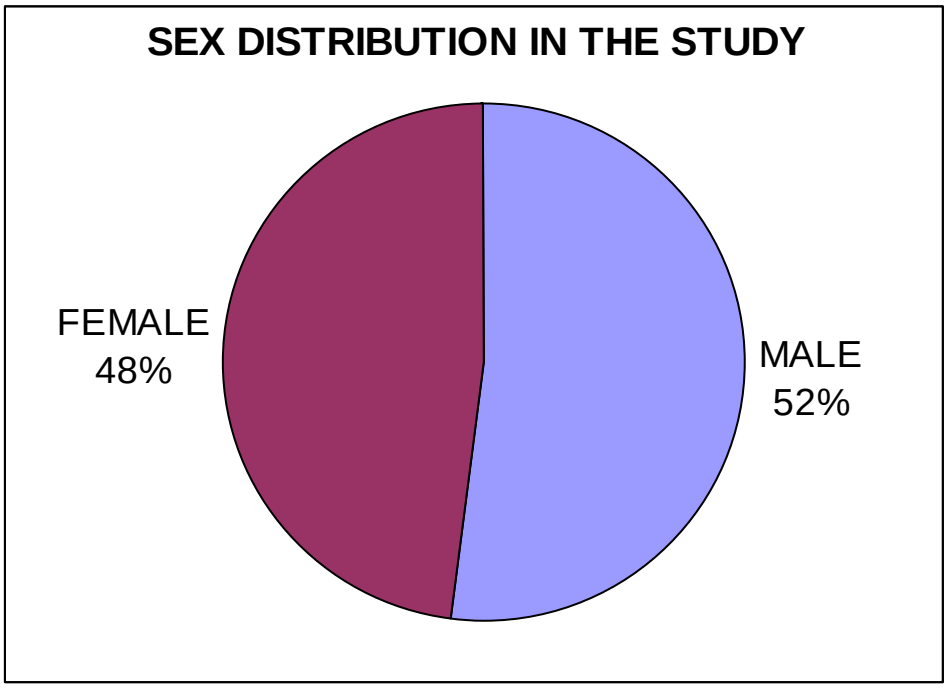
Urine Albumin Sugar Deposits

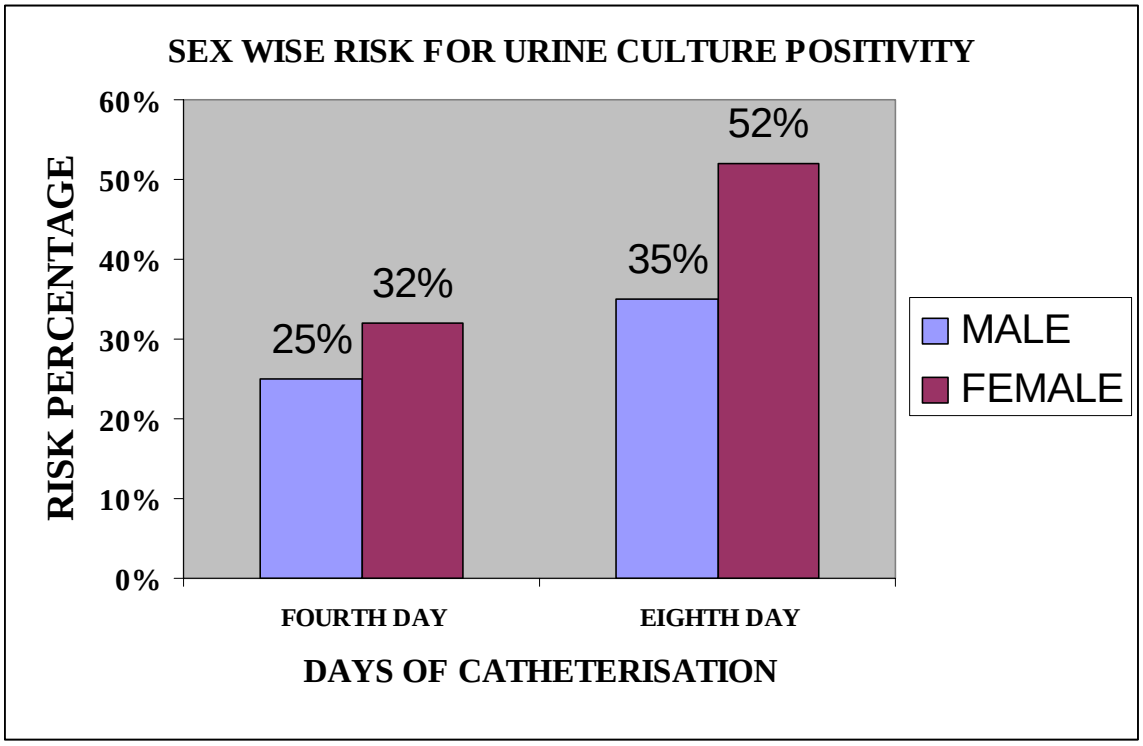
Urine culture and sensitivity

Organism grown

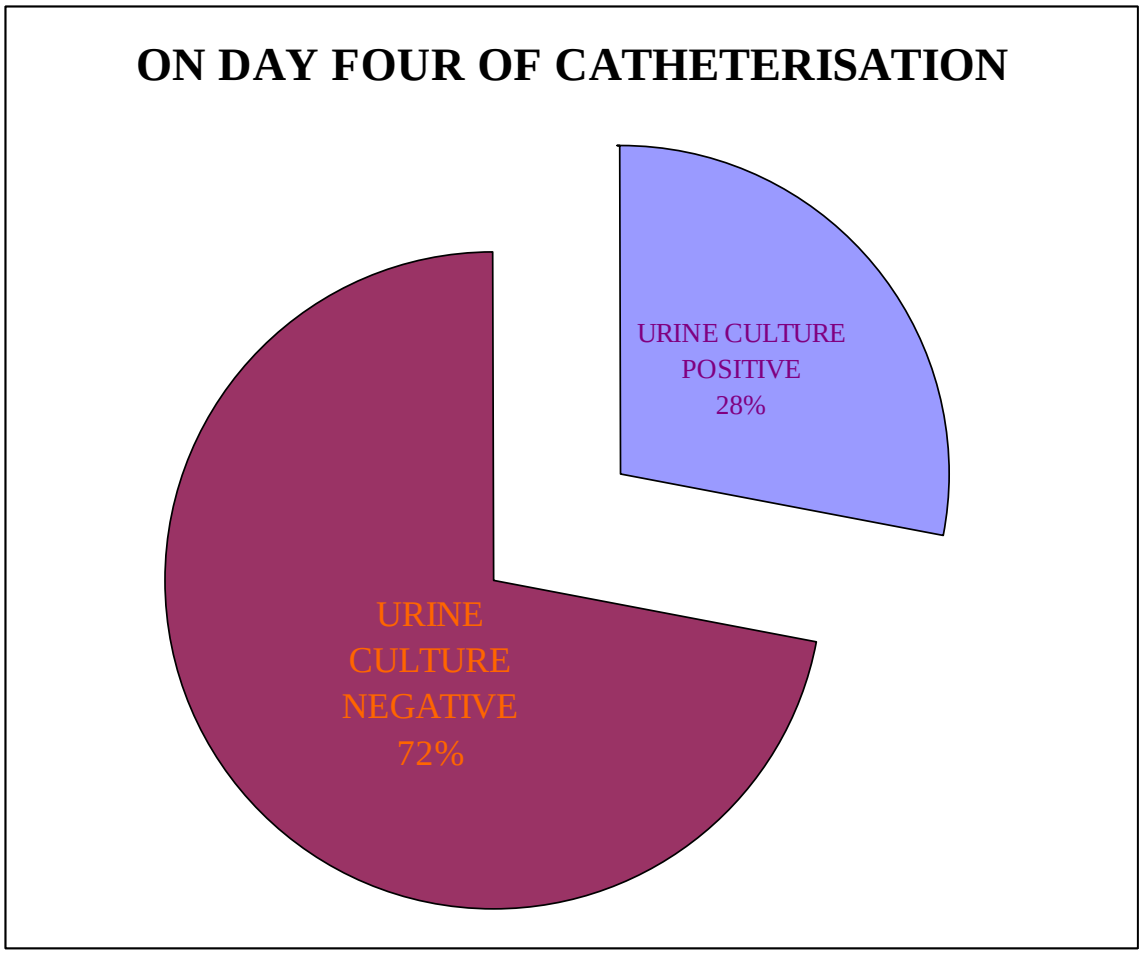
Sensitive

Resistant

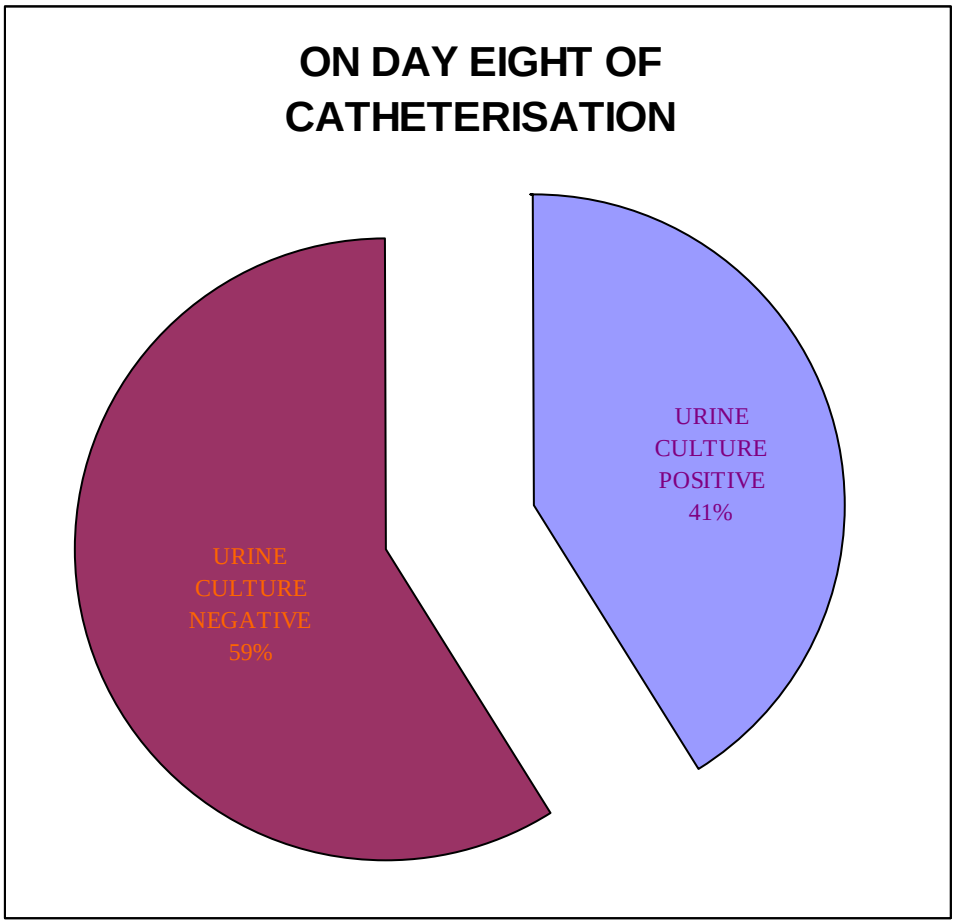

SEX DISTRIBUTION IN THE STUDY
FEMALE
48%
MALE
52%


SEX WISE RISK FOR URINE CULTURE POSITIVITY
RISK PERCENTAGE
60%
50%
40%
30%
20%
10%
0%
25%
32%
35%
52%
FOURTH DAY
EIGHTH DAY
DAYS OF CATHETERISATION
MALE
FEMALE

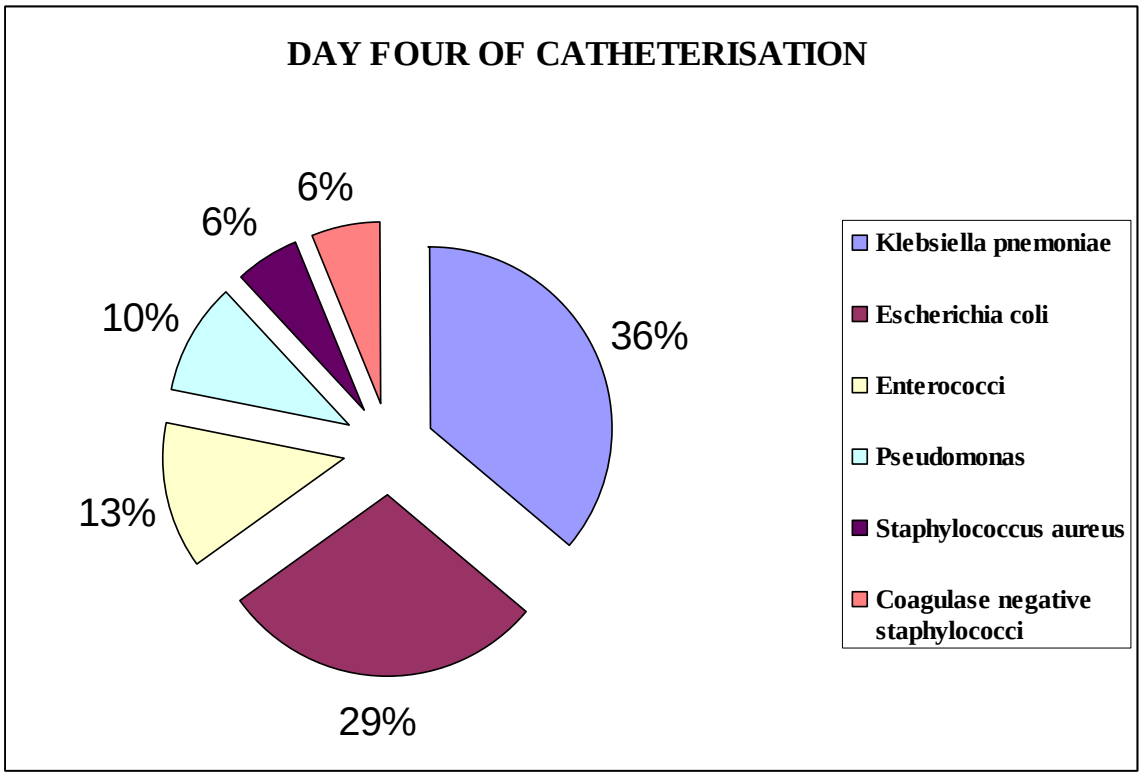
URINE CULTURE RESULTS



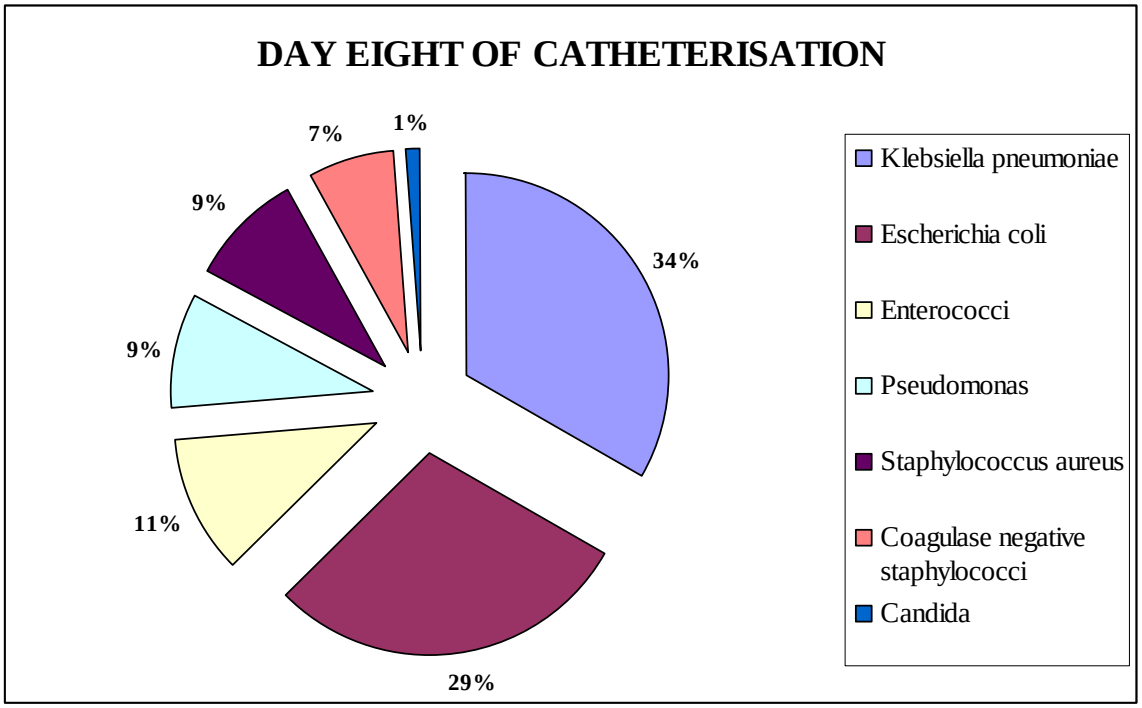
URINE CULTURE RESULTS

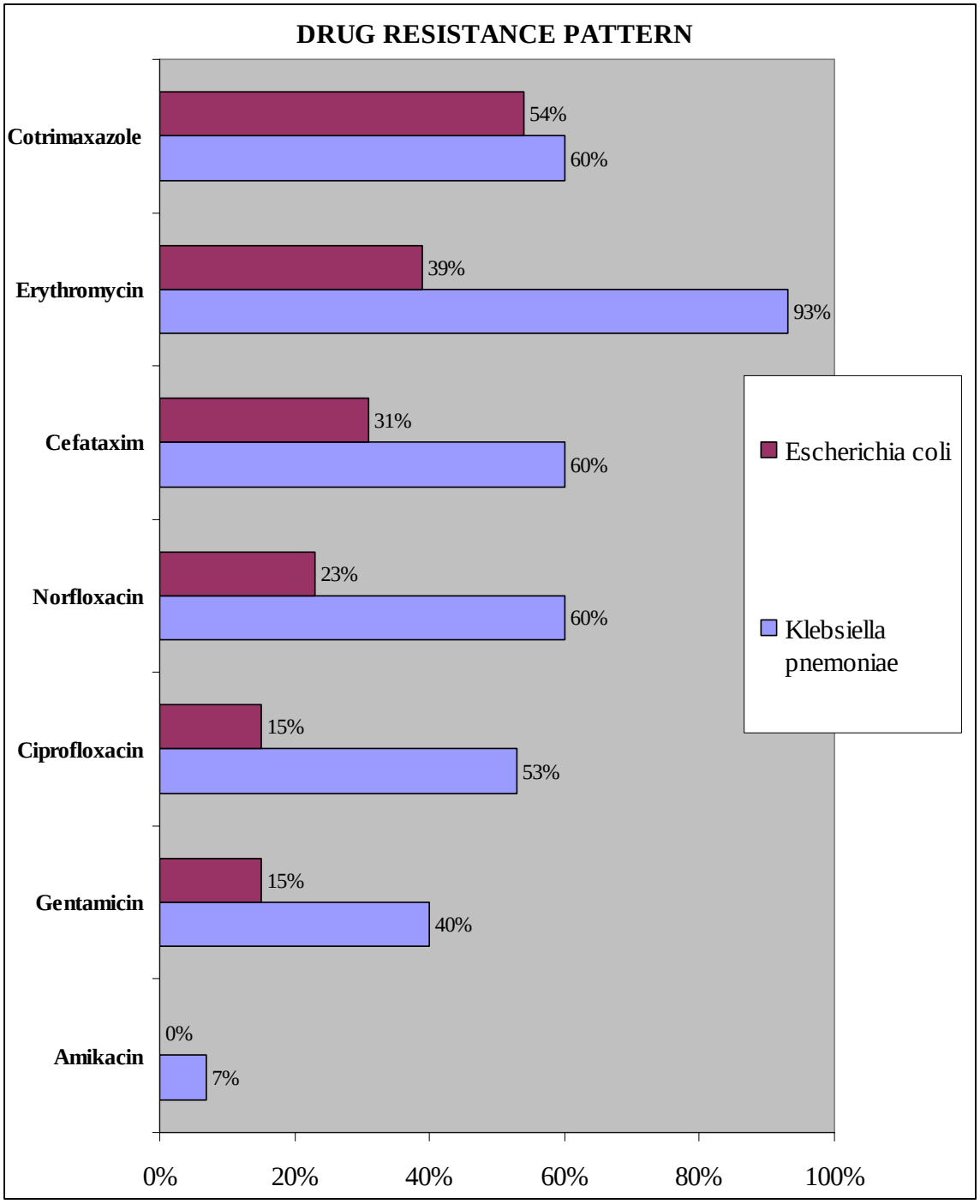


ORGANISMS GROWN IN URINE CULTURE



ORGANISM GROWN IN URINE CULTURE




DRUG RESISTANCE PATTERN
Cotrimaxazole
54%
60%
Erythromycin
39%
93%
Cefataxim
31%
60%
Norfloxacin
23%
60%
Ciprofloxacin
15%
53%
Gentamicin
15%
40%
Amikacin
0%
7%
Escherichia coli
Klebsiella pnemoniae
0%
20%
40%
60%
80%
100%

SYMPTOM PROFILE